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XI. *An Appendix to a Paper on the Nervous Ganglia of the Uterus, with a further Account of the Nervous Structures of that Organ.* By ROBERT LEE, M.D., F.R.S., Coll. Reg. Med. Socius.

Received June 16,—Read June 16, 1842.

FROM the functions of the human uterus, GALEN inferred that it must be supplied with nerves, but there is no evidence to prove that GALEN, or any of the celebrated anatomists who flourished before the middle of the eighteenth century, ever traced the great sympathetic and sacral nerves into the uterus, or discovered that its nerves enlarge during pregnancy. This was first done by Dr. W. HUNTER, who describes the hypogastric nerve on each side as passing to the gravid uterus, behind the hypogastric vessels, and spreading out in branches like the portio dura of the seventh pair, or like the sticks of a fan, with many communications over the whole side of the uterus and vagina. As Dr. HUNTER never examined the nerves of the unimpregnated uterus, and saw the nerves of the gravid uterus dissected only in one subject, he did not certainly know that they increased after conception. “I cannot,” he observes, “take upon me to say what change happens to the system of uterine nerves from utero-gestation, but I suspect them to be enlarged in proportion as the vessels*.”

Mr. JOHN HUNTER denied that the nerves of the uterus ever enlarged during pregnancy. “The uterus in the time of pregnancy,” he says, “increases in substance and size, probably fifty times beyond what it naturally is, and yet we find that the nerves of this part are not in the smallest degree increased. This shows that the brain and nerves have nothing to do with the actions of a part, while the vessels which are evident increase in proportion to the increased size; if the same had taken place with the nerves, we should have reasoned from analogy†.” Dr. WILLIAM HUNTER left no preparations of the nerves of the uterus, nor did Mr. J. HUNTER, in support of their conflicting statements, and at the beginning of the year 1838 I believe there were no preparations in this country, showing the nerves of the uterus dissected, either in the unimpregnated or gravid state. Sir ASTLEY COOPER then maintained, that it was impossible for the nerves of the uterus, or the nerves of any other organ, to increase under any circumstances.

In 1822 Professor TIEDEMANN published a description of the nerves of the uterus with two engravings. In the first, the spermatic nerves are represented on both sides accompanying the spermatic arteries to the ovaria. The spermatic veins, and the

* An Anatomical Description of the Human Gravid Uterus. Lond. 1794, p. 21.

† The works of J. HUNTER, vol. iii. p. 117. A.D. 1837.

nerves which followed them, are not seen. A few small branches of nerves from the hypogastric plexus are seen ramifying on the posterior and inferior surface of the uterus with the uterine arteries. The whole of the superior part of the uterus is covered with peritoneum. In the second Plate some small branches from the left hypogastric nerve, before it enters the great ganglion at the cervix, are seen accompanying the left uterine artery on the left side of the lower part of the uterus. From Professor TIEDEMANN'S work it might justly be inferred, that the human gravid uterus is more sparingly supplied with nerves than any other organ in the body*.

In 1823 Professor LOBSTEIN stated that the uterus before and after conception had a very scanty supply of nerves, "*Rarissime in uteri substantiam tum vacui tum gravidi sese immittere videntur nervorum surculi*†."

In 1829 Professor OSIANDER affirmed that the nerves of the human uterus had never been seen, either by himself or by any other anatomist, and that he had been deceived by the authority of scientific persons, when he stated that nerves were spread over the whole uterus.

On the 8th of April, 1838, while dissecting a gravid uterus of seven months, I accidentally observed the trunk of a large nerve proceeding upward from the cervix to the body of the uterus along with the right uterine vein, and sending off branches in its course to the posterior surface of the uterus, some of which accompanied the ramifications of the vein, and others were inserted into the peritoneum. A broad band, resembling a plexus of nerves, was seen extending across the posterior surface of the uterus, and covering the nerve midway between the fundus and the cervix. On the left side the same appearances were seen, and several branches of the nerves accompanying the uterine vein were distinctly continuous with branches of the great plexus crossing the body of the uterus. The preparation was placed in the museum of St. George's Hospital on the 1st of October, 1838. Several eminent anatomists, to whom I showed the preparation, thought that I had been misled by appearances, and that they were absorbent vessels accompanying the veins and tendinous fibres, spread across the posterior surface of the uterus. They all acknowledged that they had never seen nor dissected the nerves of the uterus, either in the human subject or in any of the lower animals. I resolved, when another opportunity should present, to follow the sympathetic into the gravid uterus, with the utmost care, that I might discover, if possible, the nature of the great plexuses covering its surface.

On the 18th of December, 1838, a woman in the sixth month of pregnancy died in St. George's Hospital, a few hours after the foetus and its appendages had been expelled; the uterus was removed with all its blood-vessels and nerves remaining connected with it, and the great sympathetic and sacral nerves were traced to the different parts of the uterus, while the preparation was under alcohol.

In a communication to this Society, which was read on the 12th of December, 1839,

* *Tabulæ Nervorum Uteri*, fol. Heidelbergæ, 1822.

† *De Nervi Sympathetica Humani Fabrica*, &c. Paris, 1823, p. 31.

I described the appearances displayed in these dissections, and represented by figures the spermatic, hypogastric, and sacral nerves passing into four great plexuses under the peritoneum of the body of the uterus. From the form, colour, vascularity, and general distribution of these plexuses, and from their branches actually coalescing with those of the great sympathetic, I inferred that they were true nervous ganglionic plexuses, and formed the nervous system of the uterus. Some anatomists of reputation formed a different opinion, and concluded that they were nothing but bands of elastic tissue, gelatinous tissue, or cellular membrane connecting the peritoneum with the muscular coat of the uterus. All who examined the dissections admitted that the plexuses were accompanied with arteries, and were continuous with the spermatic and hypogastric nerves. None attempted to show in any other part of the body, bands of elastic tissue assuming a similar plexiform appearance, accompanied with arteries or continuous with nerves. The communication was withdrawn from the Royal Society.

I continued the investigation of this subject during the whole of 1840 and 1841, and discovered the great nervous ganglia at the neck of the uterus, a description of which is contained in the last volume of the *Philosophical Transactions*. But these ganglia, which exceed in size the semilunar ganglia of the great sympathetic, constitute only a small portion of the nervous system of the human uterus. I propose now briefly to describe other nervous structures of far greater size, as displayed in the dissection of a gravid uterus at the end of the ninth month of pregnancy.

In this preparation the great sympathetic nerve sends numerous branches from both its cords to the trunk of the inferior mesenteric artery, which form a great plexus around it. These nerves accompany all the ramifications of the artery, but the greater number proceed with the hemorrhoidal artery to the rectum. The two cords of the great sympathetic, after giving off these branches to the inferior mesenteric artery, pass down before the aorta nearly two inches below its bifurcation, where they are united by several fine nervous filaments. But the cords continue distinct, and soon separating, each passes down behind the hypogastric blood-vessels to the side of the neck of the uterus, and there terminates in the corresponding hypogastric or utero-cervical ganglion. The left cord of the great sympathetic, or as it is usually called, the hypogastric nerve, enlarges greatly as it approaches the hypogastric ganglion. This ganglion is nearly two inches in breadth, and covers a great part of the cervix uteri. It appears to consist of six or seven smaller ganglia, which are united together by nervous cords. Each of these ganglia is a thick solid nervous mass, of an orange white colour inclined to brown. Arteries which have been injected pass through these smaller ganglia and accompany the various nervous filaments which proceed from them. Into the whole outer surface of the left hypogastric ganglion, numerous branches from the third sacral nerve enter; and behind there is a great connection formed between the ganglion and the branches of the left hemorrhoidal nerve. The vaginal nerves arise from the inferior margin of the ganglion, and the vesical from its anterior border. Some of these nerves pass on the outside of the

ureter to enter the middle vesical ganglion, and others pass on the inner surface of the ureter to the anterior part of the neck of the uterus.

From the superior and anterior part of the left hypogastric ganglion, a plexus of nerves accompanied by an injected tortuous artery, proceeds upward along the whole body of the uterus, near the left side, to the trunk of the left spermatic vein, and there terminates in a dense, reddish brown coloured mass, consisting of fibres firmly interlaced together, and which has all the characters of a true nervous ganglion. From its vicinity to the principal spermatic artery and vein which it partly surrounds, and the ligament of the ovary, it may be called the *left spermatic ganglion*. Between this ganglion and the left hypogastric ganglion, an artery extends which is closely embraced by a plexus of nerves, and a direct nervous communication is thus established between these remote ganglia. The nerves adhered so firmly to the artery through its whole course, that before they were separated they presented the appearance of two white lines on its sides, with filaments crossing over the vessel. From these nerves extending between the left hypogastric and spermatic ganglion, branches with arteries are given off in their whole course to the *subperitoneal ganglia* and *plexuses* on the posterior surface of the uterus, and also branches to the plexuses on the anterior surface. On approaching the spermatic ganglion, these nerves with their artery pass under or between the branches of the *left subperitoneal plexuses* and frequently communicate with them by fine nervous filaments. The artery can be readily traced through the substance of the spermatic ganglion, but the nerves which accompany it from the hypogastric ganglion, immediately disappear on entering the mass. Numerous large branches of nerves from the left subperitoneal plexus likewise terminate in the left spermatic ganglion, but some of them pass under it, and proceed to the round ligament; and others are continued upward, gradually diminishing in size as they approach the renal plexus along the spermatic blood-vessels. From the upper border of this ganglion, large flat nerves proceed to ramify on the fundus uteri, and pass with the vessels into the muscular coat. The trunk of the spermatic vein and artery is almost completely surrounded with this ganglion, as the trunks of the uterine, and vaginal arteries and veins are inclosed within rings of nerve connected with the hypogastric ganglion.

In this dissection there are nervous structures displayed on the anterior and posterior surfaces of the uterus of still greater magnitude. These, from their situation, may be called the *subperitoneal ganglia* and *plexuses* of the uterus.

Over the middle of the lower part of the body of the uterus behind, immediately beneath the peritoneum, is situated the posterior subperitoneal ganglion, which is considerably larger than the left hypogastric ganglion. It presents the appearance of a layer of dense structure composed of fibres strongly interlaced together, having a yellowish brown colour. It adheres firmly to the peritoneum, but between its lower surface and the muscular coat of the uterus, there is interposed a thick soft layer of cellular substance, through which filaments of nerves and branches of con-

siderable size pass to the muscular coat of the uterus. The middle part of the ganglion is more than two lines in thickness, but it becomes everywhere thinner towards the circumference, and particularly at the inferior border, where it sends off many nerves to the back part of the vagina. From its left lower and lateral part, it sends off two layers of broad nerves, one of which adheres to the peritoneum, and the other closely invests the muscular coat and blood-vessels of the uterus. Between these layers there is placed a very thick mass of soft cellular membrane, through which innumerable branches of nerves pass between these layers, the hypogastric ganglion, and the plexus of nerves with the injected artery extending between the hypogastric and spermatic ganglia. Many of the superficial nerves pass down under the peritoneum, and terminate in the upper border of the left hypogastric ganglion, and upon these superficial nerves there is formed another ganglion of considerable size, between which and the hypogastric nerve numerous branches of soft nerves extend. This ganglion formed on the nerves under the peritoneum near the edge of the uterus, is thick and solid, and consists of a yellowish brown substance, with white nervous filaments interlaced, and arteries of considerable size passing through it. From its lower border large nerves extend to the upper edge of the hypogastric ganglion, and innumerable soft nerves enter the whole inner surface of the hypogastric ganglion, which take their origin from the lower part of the great subperitoneal ganglion. The upper part of this ganglion becomes firmly adherent both to the peritoneum and muscular coat of the uterus, which it covers as high as the fundus. Large broad nervous plexuses, superficial and deep, extend from the upper portion of the subperitoneal ganglion across the body of the uterus to the spermatic ganglion, and blood-vessels, and the round ligament, around which they form a sheath of nerves.

In an elaborate drawing by Mr. JOSEPH PERRY, all the ganglia and plexuses on the left side of the uterus now described, have been represented with the greatest fidelity.

As the arteries and veins on the right side of the uterus are only partially injected, the nerves extending between the hypogastric and spermatic ganglia have not been so minutely traced. But that there is a similar nervous chain connecting these great ganglia of the fundus and cervix and the subperitoneal ganglia and plexuses, does not admit of doubt, and has been clearly demonstrated by other dissections at an earlier period of pregnancy.

Over the middle of the anterior and lower part of the body of the uterus, there is situated a nervous and vascular mass, of great extent, and similar in structure to the subperitoneal ganglia described on the posterior surface. It adheres to the peritoneum firmly, but on being divided longitudinally, it is also observed to be separated from the muscular coat of the uterus by a soft stratum of cellular membrane. From the lower part of this *anterior subperitoneal ganglion* nerves are sent down to the cervix uteri and vagina, and numerous branches pass off on both sides to the hypogastric ganglia. Superficial and deep plexuses of nerves are likewise sent off from its superior lateral borders, which proceed across the uterus, sending branches into

the muscular coat, and uniting with all the ganglionic plexuses on the posterior surface. The appearances presented by the anterior subperitoneal ganglia and plexuses in the fourth month of pregnancy, have been displayed in the second engraving which illustrated the paper on the nervous ganglia of the uterus. At that period the ganglion seemed nothing but a thin nervous and vascular membrane, imbedded in soft cellular substance, through which the delicate nervous filaments accompanied with arteries proceeded to the superior angles of the uterus. On comparing this dissection with that now described, it is impossible to avoid being struck with the enormous development of these nervous structures during the four latter months of pregnancy, or to resist the conclusion that these are formed for the purpose of supplying the uterus with that nervous power which it requires during labour.

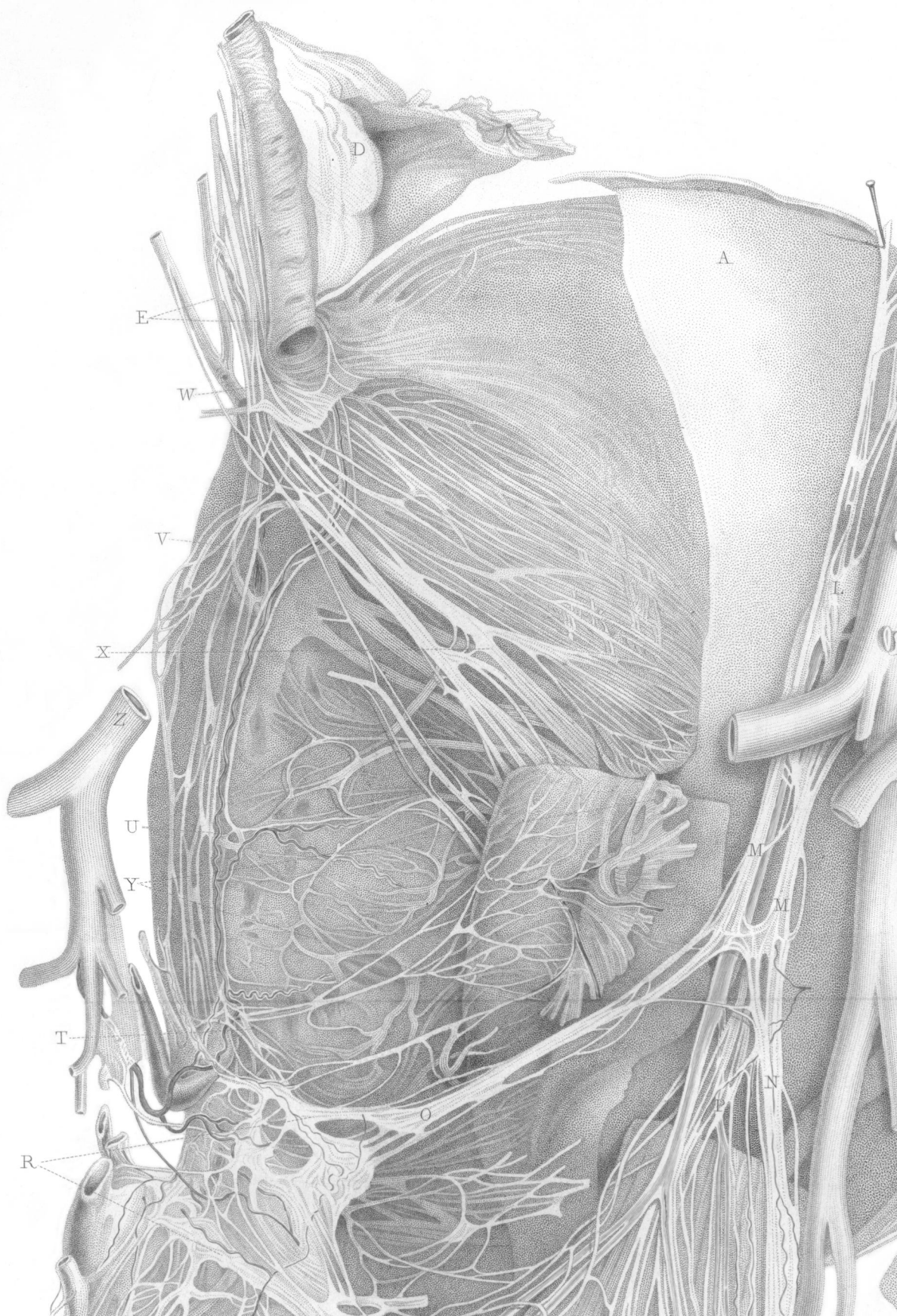
These dissections prove that the human uterus possesses a great system of nerves, which enlarges with the coats, blood-vessels and absorbents during pregnancy, and which returns after parturition to its original condition before conception takes place. It is chiefly by the influence of these nerves, that the uterus performs the varied functions of menstruation, conception, and parturition, and it is solely by their means, that the whole fabric of the nervous system sympathises with the different morbid affections of the uterus. If these nerves of the uterus could not be demonstrated, its physiology and pathology would be completely inexplicable.

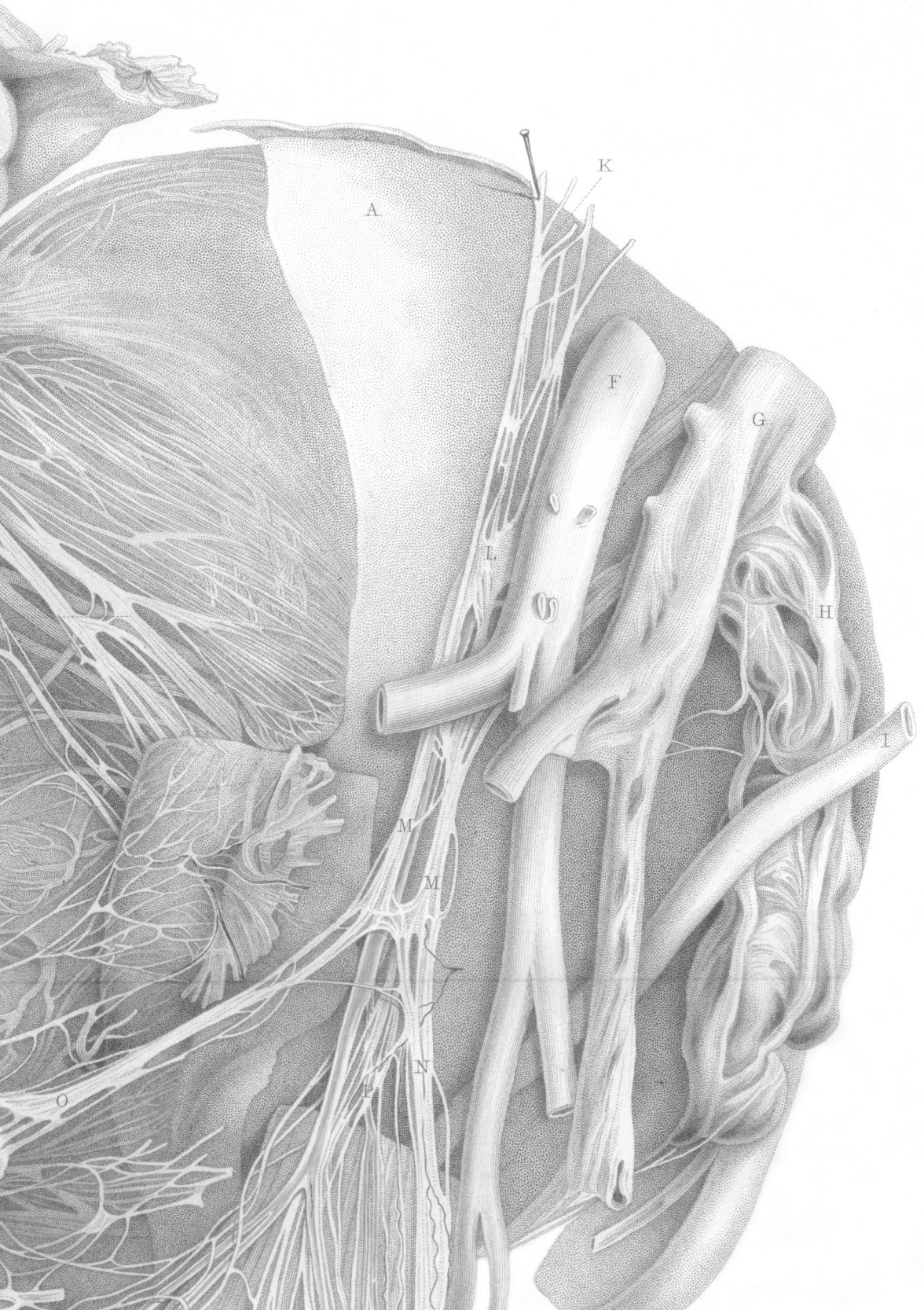
EXPLANATION OF THE PLATE.

PLATE XIV.

Exhibits the ganglia and nerves on the posterior and left side of the gravid uterus at the end of the ninth month of pregnancy.

- A. The fundus and body of the uterus, having the peritoneum dissected off from the left side.
- B. The vagina covered with nerves proceeding from the inferior border of the left hypogastric ganglion.
- C. The rectum.
- D. The left ovarium and Fallopian tube.
- E. The trunk of the left spermatic vein and artery surrounded by the left spermatic ganglion.
- F. The aorta divided a little above the origin of the right spermatic artery, and about three inches above its division into the two common iliac arteries.
- G. The vena cava.
- H. Trunk of the right spermatic vein entering the vena cava.
- I. Right ureter.
- K. The two cords of the great sympathetic nerve passing down along the front of the aorta.









- L. Trunk of the inferior mesenteric artery passing off from the aorta, and covered with a great plexus of nerves sent off from the left and right cords of the great sympathetic.
- M. M. The two cords of the great sympathetic passing down below the bifurcation of the aorta to the point where they separate into the right and left hypogastric nerves.
- N. The right hypogastric nerve with its artery injected proceeding to the neck of the uterus, to terminate in the right hypogastric ganglion.
- O. The left hypogastric nerve where it is entering the left hypogastric ganglion and giving off branches to the left subperitoneal ganglion.
- P. Hemorrhoidal nerves accompanying the hemorrhoidal artery and proceeding from the great plexus which surrounded the inferior mesenteric artery.
- Q. The sacral nerves entering the whole outer surface of the hypogastric ganglion.
- R. The left hypogastric ganglion with its arteries injected.
- S. The nerves of the vagina.
- T. Nerves with an injected artery proceeding from the upper part of the left hypogastric ganglion along the body of the uterus, and terminating in the left spermatic ganglion.
- U. Continuation of these nerves and the branches which they give off to the subperitoneal plexuses.
- V. The same nerves passing upward beneath the subperitoneal plexuses, and anastomosing freely with them.
- W. The left spermatic ganglion, in which the nerves and artery from the hypogastric ganglion, and the branches of the left subperitoneal plexuses terminate, and from which the nerves of the fundus uteri are supplied.
- X. The left subperitoneal plexuses covering the body of the uterus.
- Y. The left subperitoneal ganglion with numerous branches of nerves extending between it and the left hypogastric nerve and ganglion.
- Z. The left common iliac artery cut across and turned aside, that the left hypogastric nerve and ganglion might be traced and exposed.